LFG Field Monitoring Part 1

Specialized landfill gas (LFG) systems are used to extract, collect and control gas migration and surface emissions. At some sites the LFG is collected for its energy value. Proper control ensures the safety and welfare of the public and environment. Specialized LFG systems are designed for:

- Primary LFG well field collection
- Perimeter gas migration control
- Migration monitoring at property lines and at buildings on the landfill

Conceptually, these systems radiate out in a series of concentric rings, each ring having a different function and purpose. They must be properly operated and monitored so that landfill gas extraction is maximized and the potential for problems is minimized. The landfill technician collects data and makes decisions and adjustments (referred to as turning the extraction system) based on the monitoring data collected from each system.

Primary Well Field Monitoring

The interior well field is the largest LFG extraction system. Its function is to collect most of the landfill gas generated within the landfill. It normally includes a number of evenly spaced wells over the entire landfill. If the landfill is active, some sections may be disconnected or shut off because of filling. This obviously puts additional requirements on the perimeter migration control system. Improper operation of the primary well field can result in excess emissions of LFG to the atmosphere, gas migration and overpulling of the well field which can disrupt anaerobic decomposition or cause subsurface fires.

The frequency of landfill gas well monitoring will vary depending upon field requirements and conditions. Normal monitoring frequency for a complete field monitoring session will vary from once a week to once a month. Well field monitoring should not normally be extended beyond once a month, especially on active landfills because too much can happen to the landfill gas extraction system. The importance of regular, timely and thorough monitoring cannot be over emphasized. If properly operated, high methane gas is extracted from the well field which can be used for energy production or as the primary fuel for a flare.

Perimeter LFG Migration Control

Perimeter gas collection wells extract poor quality LFG that is often high in oxygen due to air intrusion at the interface of the landfill and the native soil. Operating objectives for the perimeter system are different than the primary well field LFG extraction system. The perimeter system also provides a final opportunity to capture gas before it escapes from the landfill. Landfill depth can change dramatically at the perimeter, making gas quality and control difficult. For this reason, perimeter gas wells are often tied into a separate system. In some special circumstances migration control wells are put into native soil adjoining the landfill.

Some perimeter migration systems are monitored daily, if perimeter LFG monitoring probe's readings are above established limits. In other cases, the perimeter system is monitoring once every week or two. Subsurface fires, caused by air intrusion, can easily occur in perimeter migration wells if they are operated at high extraction rates. In general, perimeter migration wells are the most frequently monitored of the various systems. LFG migration is usually decreased if the interior well field

pulls gas towards the center of the landfill instead of allowing the LFG to be pulled toward the perimeter system. Then, the perimeter migration system only has to extract locally generated gas rather than gas already migrating towards the perimeter.

LFG Migration Monitoring

Shallow and deep LFG migration probes are placed at key locations around the landfill. They are often placed at the property boundaries (or a reasonable distance from the landfill) and at support buildings on the landfill property. They are monitored on a regular basis. If problems are encountered the can be read daily. In other, more stable conditions they can be read as seldom as once per month. The EPA's Subtitle D regulation requires that methane be kept below 5% (the Lower Explosive Limit – LEL of methane) at the property boundary and less than 1.25% (25% of LEL) at any structure on or near the landfill. It also requires that probes be monitored at least quarterly. The EPA's definition of the term "structure" is broad and includes culverts and drains. If levels are exceeded, Subtitle D has specific requirements as to what actions must be taken including: immediate steps to protect human health, putting the facts in the official operating record of the landfill, implementing a remediation plan and notifying the EPA or state director of the event within a specified time frame.

Complete Field Readings

- Normally, a complete set of primary well field readings consists of the following:
- Name of technician taking readings, equipment used and when/how it was calibrated or checked for accuracy
- ID of each monitoring point (well or probe)
- Date/time of each gas reading
- Methane (CH4) percentage of total gas sample (essential)
- Oxygen (O2) percentage of total gas sample (essential)
- Carbon dioxide (CO2) percentage of total gas (nice to have)
- Balance gas percentage – primary nitrogen (nice to have)
- Gas temperature and ambient temperature
- Static pressure (Ps), i.e. the vacuum available at the wellhead
- Velocity head or the differential pressure (ΔP) which can be used to calculate gas flow of velocity at the wellhead
- Heat value (Btu) for each individual well and totaled for the entire collection system (nice to have)
- Wellhead adjustment valve position (initial and adjusted), i.e., is the valve wide open, or partially open
- New wellhead vacuum and flow information after adjustment
- A calculation of each well's LFG and methane flow is necessary and should be summed for all wells. This should be compared with other meters which totalize combined flows at a flare or energy system. The totals should be similar.
- Observations/comments taken while reading wells, i.e. noting repairs, problems, etc. at or near each monitoring point.

If Problems are Suspected or Encountered

Improper operation of LFG extraction systems can cause underground fires (see Technical Tips # 101), surface emissions, gas migration or disruption of anaerobic decomposition. All denote problems that must be addressed. If a subsurface fire is suspected, the gas can be sampled for carbon monoxide (CO) which is an indicator of combustion. In addition, surface temperature soil surveys may help to locate monitoring programs must be developed.

Supplementary Monitoring

Depending on requirements, supplementary monitoring is done on a daily to quarterly basis. It is usually an abbreviated or specialized form of field reading which has specific goals associated with certain monitoring points such as at perimeter monitoring probes, migration wells or problem wells and includes:

- Name of technician taking readings, equipment used, etc.
- Date/time of each reading
- ID of each monitoring point
- Methane (CH4) LEL or volume percentage as appropriate (essential)
- Oxygen (O2) percentage of total gas sample (essential)
- Carbon dioxide (CO2) percentage or total gas (nice to have)
- Wellhead gas temperature (flowing)
- Wellhead static pressure (Ps)
- Wellhead gas flow
- Wellhead adjustment valve position (initial and adjusted)
- New wellhead vacuum and flow information after adjustment
- Observations/comments taken while reading wells or probes

The determination of which readings to include in the abbreviated set is based on field monitoring needs. Additional data is often used to fine tune the gas extraction systems to deal with special problems or conditions.

For long term extraction system performance, line vacuums and gas quality data may be taken at key points along the main gas collection header and subordinate branches. This helps to identify locations of poor performance, excessive pressure drop, or leakage. Such information is most helpful when a leak or significant collection system problems occurs. Additional baseline information is often compared with system performance monitoring of the various systems to determine if lines have developed leaks, been crushed, sheered off, filled with condensate, or wells have watered-in thereby reducing flow.

Additional Well Field Monitoring Activities

Walking the landfill must be done on a regular basis. It is still the best way to find small leaks of determine if specific maintenance is necessary. On foot, the landfill technician will hear and see many things that are missed from a vehicle. Often surging condensate in collection lines between monitoring wells is missed. Subsidence, fissures and even wisps of smoke from a subsurface fire are more easily detected on foot.

Surface Emissions Monitoring for "Hot Spots"

Increasing emphasis is being placed on controlling landfill gas emissions to the atmosphere. In some instances, regulations require collection and destruction of LFG to reduce nuisance effects, to control its contribution to global warming as a green house gas, and to reduce the contribution to photochemical smog. One performance oriented approach uses surface emissions monitoring to identify and track emission "hot spots" where LFG may be leaking through the surface of the landfill. Other approaches may focus on testing, collection system design criteria, or collection efficiency evaluation.

Further Discussions – LFG Field Monitoring Part II

Part II will address record keeping, necessary equipment for proper monitoring and other monitoring issues that lead to the proper tuning of the landfill gas control systems. Good well field adjustment cannot be done without adequate LFG field monitoring.

Additional LANDTEC Information

LANDTEC's landfill products are designed specifically to work together in landfill applications. Additional product information is available on landfill gas collection products, measurements & instrumentation equipment, condensate/leachate treatment systems, flares and landfill gas management software. Please call our toll-free number 1-800-821-0496 (8 a.m. – 5 p.m. West Coast time) for additional information or placement on out mailing list.

The above suggestions and information does not apply to all landfills or situations and is offered only as a generic guideline.

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